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(Air Raid Precautions Department)

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GENERAL PREFACE

The series of Air Raid Precautions Handbooks (of which a list is given on the opposite page) is produced under the authority of the Secretary of State, by the Air Raid Precautions Department of the Home Office with the assistance of other Government Departments concerned.

The measures for safeguarding the civil population against the effects of air attack which these Handbooks describe have become a necessary part of the defensive organisation of any country which is open to air attack. The need for them is not related to any belief that war is imminent. It arises from the fact that the risk of attack from the air, however remote it may be, is a risk that cannot be ignored, and because preparations to minimise the consequences of attack from the air cannot be improvised on the spur of the moment but must be made, if they are to be effective, in time of peace.

For the purpose of the measures now to be taken, it must be assumed that the scale of attack would greatly exceed anything which was experienced in the last war, and would involve the use of high explosive and incendiary bombs.

The use of poison gas in war is forbidden by the Geneva Gas Protocol of 1925, to which this country and all the most important countries of western Europe are parties, and the Government would use every endeavour on an outbreak of war to secure an undertaking from the enemy not to use poison gas. Nevertheless, the risk of poison gas being used remains a possibility and cannot be disregarded.

The Handbooks are designed to describe a scheme of precautions which it is hoped would prove effective in preventing avoidable injury and loss of life, or widespread dislocation of national activities. The Handbooks aim at giving the best available information on methods of passive defence against air attack, and will be revised from time to time in the light of future developments.

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INTRODUCTION

The purpose of this Handbook is to provide information, of both a general and technical nature, required by nurses and by first aid parties and the personnel of first aid posts to enable them to carry out their respective duties as part of local air raid precautions schemes.

It is also intended to be used by the first aid personnel organised by large undertakings, factories and business premises.

It is assumed that these persons will be fully acquainted with the contents of A.R.P. Handbook No. 1, which deals with personal protection against gas, and gives a general description of the nature and dangers of war gases.

For the convenience of the reader, certain parts of the information contained in Handbook No. 1 are repeated. But the two handbooks are complementary, and it is intended that they should be read and used together.

A new chapter on the nursing of gas cases has been introduced in this edition, to guide nurses in the proper performance of their professional duties. Full guidance on the diagnosis and treatment of gas cases is contained in A.R.P. Handbook No. 3, which has been specially prepared for the medical profession.

First Edition ("Anti-Gas Precautions and First Aid for Air Raid Casualties"), July, 1935. (86,350 copies.)

Second Edition ("First Aid for Gas Casualties"), September, 1936. (280,000 copies.)

Third Edition ("First Aid and Nursing for Gas Casualties"), March, 1938.

CHAPTER I

THE CHEMICAL SUBSTANCES DEALT WITH

1. Classification of Gases

The following classification of the chemical substances likely to be met with under war conditions, which is that adopted in A.R.P. Handbook No. 1, is considered to be that most helpful to first aid personnel.

It is based upon the effects which these substances produce upon the human body, and not upon the chemical composition of the gases.

Each group may contain many members, which differ from each other chemically: but the members of each group have a similar action on the body, and produce similar first aid problems.

From the first aid point of view, the substances to be studied may be classified as belonging to the following groups:—

(*a*) Tear gas
(*b*) Nose Irritant Gas
(*c*) Lung Irritant Gas
(*d*) Blister Gas

Before going further it is well to remember that, whilst the term "gas" is retained because it is convenient and has become sanctioned by use, it is not an accurate description of the substances which are being studied. Some are actually gases, some are liquids, and some are solids. The one thing they all have in common is that they are more or less dangerous and poisonous.

The grouping being according to their action the group names are, to a large extent, self-explanatory. Thus, Tear Gases act upon the eyes; Lung Irritant Gases act upon the organs of breathing; Blister Gases burn and blister.

For completeness, one more group must be added—

(*e*) poisonous substances met with in war but not actually used as offensive agents.

CHAPTER II

WAR GASES OTHER THAN BLISTER GASES

2. Tear Gas

Tear gas, as its name implies, acts upon the eyes. It produces acute pain, profuse outpouring of tears, and spasm of the eyelids.

The result may be serious interference with vision, even complete inability to see. But the effect is normally only of a temporary nature.

It is very important to remember that inability to see does not necessarily mean blindness. The members of this group of gases do so very little damage, either to the eye or to the sight, that the question must arise as to whether first aid is really necessary.

Viewed from the usual angle, early treatment of some physical injury, there is very little need for first aid. The protection of the eyes from the poison, either by removal to fresh air or donning a respirator, plus simple washing of the eyes with warm water, or some mild solution such as normal saline (one teaspoonful of salt to one pint of water), is all that is required. The effect will normally have entirely disappeared in a very short time.

But there is another, and most important aspect of these effects, and that is the psychological or mental side.

It does not require much imagination to realise that an individual afflicted with the symptoms given above is going to be very frightened, and it is here that the coolness and firmness of the trained first aid personnel, based on a thorough understanding of the situation, are of such great value: of value not only to the individual but to the community. Of value to the individual because it will quieten his fear of permanent injury. Of value to the community because an understanding that nothing serious has happened will enable the casualties to be dealt with promptly and finally, and will prevent them from being evacuated to hospital. If they are not dealt with by the first aid organisations as requiring simple treatment only, they may occupy space in ambulances and in hospitals to which they are not entitled, and which will almost certainly be urgently needed for other and really serious cases.

As these tear gases produce their effects even when enormously diluted, it is probable that, if any cases occur at all, there will be large numbers—a fact which increases the importance of this aspect of first aid work.

Furthermore, individual fear easily grows to crowd panic, and panic is one of the most serious dangers of a gas attack.

3. Nose Irritant Gas

This group presents much the same first aid problems as the Tear Gas group.

The symptoms produced are pain—of a rather sharp burning character—in the forehead, the nose, the face, the teeth, the gums, the throat, and the upper part of the chest, and possibly also attacks of sneezing and coughing.

A feeling of sickness, or even actual vomiting, sometimes accompanies these symptoms.

A special feature of exposure to this group is acute, and distressing, mental depression. A special watch must be kept for this symptom and it must be combated by a firm though kind attitude of cheerfulness.

In spite of the very real distress which must obviously be the result of so widespread an effect, little or no serious damage results. First aid treatment consists in attempts to lessen the pain and discomfort. Nasal douching with warm, weak, Sodium Bicarbonate solution (10 grs. to one pint) is sometimes helpful. Copious draughts of the same solution will help to relieve the vomiting, if present.

These substances are not really " gas " at all, but clouds of fine particles of solid. For this reason they are often described as " toxic " or " poisonous " smokes. Since the particles are so fine that the cloud is quite invisible to the naked eye, the problem of providing protection against them is more difficult. All respirators provided by the Government, or bearing the Government mark, will provide complete protection.

These substances, being solids and not gases, have a certain degree of persistence. This is chiefly noticeable in that the particles will cling to clothing, and to the hair, and entry into a warm room after exposure may cause the air of the room to become very unpleasant, though not dangerous in any way. For this reason it is recommended that, with respirators on, outer garments be removed and shaken in the open air if possible, before entering the house or first aid post.

Casualties from Nose Irritant Gas are of even greater importance from the " panic " point of view than the Tear Gas casualties, and for the same personal and communal reasons.

This aspect of the situation is strengthened by two factors, both of which are important. First, whilst the presence of these poisons is quickly appreciated, though not quite so instantaneously as the presence of members of the Tear Gas group, there is a very definite tendency for the symptoms to continue getting worse for some time after removal from the poisonous atmosphere.

This is very important. It will increase the fear of the individual and, if not fully understood by first aid personnel, will make more difficult the task of persuading the victim that no serious damage is to be feared. The second factor is that, as the symptoms may continue to grow worse after donning the respirator, the confidence of the wearer may be severely shaken. He may think that his respirator is leaking;

he may even discard it, thus exposing himself to attack by other and more deadly gases which may be present at the same time.

All this, plus the fact that these materials act in extremely low concentration, makes the Nose Irritant problem very important from the first aid point of view.

4. Lung Irritant Gas

In this group a problem of an entirely different order from that of the two groups so far considered has to be faced.

The members of this group can produce very serious damage, which is dangerous to life itself. This condition is not however likely to arise from slight exposure to the gas for a short time. It is necessary to look for positive symptoms.

The early symptoms, which will vary considerably both with the particular gas encountered and with the concentration, include spasm of the throat, cough, retching, and a feeling of tightness or constriction of the chest. There may be some blueness of the face, with increased rapidity of both breathing and pulse rates.

At some rather indefinite later period, sometimes quite soon, sometimes after a lapse of two or three hours or more, the symptoms of the damage to the lung begin to develop.

For this reason first aid is of great importance, and the main consideration is complete rest, and observation by a trained person, though not necessarily in hospital. Rest is particularly essential because some of the members of this group tend to have a delayed action, especially noticeable in Phosgene poisoning.

The immediate signs of this delay are a lessening of the early symptoms of coughing, retching and tightness in the chest, followed a few hours later by the development of the symptoms associated with severe damage to the lungs.

The result, from the first aid point of view, is that all casualties known to have been or even suspected of having been seriously exposed to one of these gases should be treated as stretcher cases from the outset, and not allowed to walk, even if the person concerned stoutly maintains that there is very little the matter—as often happens.

All cases may suffer pain in the chest. In some there may be but little coughing, though in others it may be a prominent and distressing symptom. Great quantities of frothy fluid may be coughed up, and vomiting is frequently also present.

At this stage the patient is obviously seriously ill, and definitely a hospital case, and the treatment and nursing, which are complicated and difficult, consist, among many other things, in the continuous administration of oxygen gas to breathe.

The majority of the deaths which occur do so within the first 48 hours from the time of onset of the serious symptoms.

It should be noted that some Lung Irritants have also the properties of Tear Gas, but only if in strong concentration and as an effect additional to the chest and other symptoms detailed above.

Rest and warmth and early evacuation to hospital are the main points of first aid for these serious and dangerous casualties.

Artificial respiration must not be carried out on those patients. The lungs are seriously damaged, and in a water-logged condition. Artificial respiration is likely to do more harm than good, and may even be itself a cause of sudden death.

For the milder cases, who may be transferred to their homes in the first instance, rest, and instructions to send for medical assistance if not appreciably recovered after a few hours, is advised. When in doubt these milder cases may be retained in first aid posts for observation.

Lung Irritant casualties may be classified into three main groups according to their mode of onset:—

(i) Acute, with violent onset.
(ii) Acute, with insidious onset.
(iii) Mild.

(i) Acute, with violent onset:—immediate coughing, choking, and spasmodic gasping for breath. Difficulty and pain on trying to take a deep breath.

(ii) Acute, with insidious onset:—example from late war experience*:—

> During the night two companies of men were doing pick and shovel work in the front line. They were suddenly subjected to an accurate fire of gas bombs (probably phosgene) from trench mortars, at 3 a.m. The men marched back some distance, only three complaining of feeling ill. About 5 a.m. they had breakfast and after the meal a number vomited and complained of difficulty in breathing. Several others woke, after a short sleep, with similar symptoms. There were subsequently many serious casualties of whom some 18 per cent. died.

(iii) Mild:—example from late war experience*:—

> The cloud came rapidly into the trenches, where coughing and spluttering were at once

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* Examples summarised from Official History of the War—Medical Services, Diseases of the War, vol. II, chap. XII.

heard on all sides. Men suffered from exhaustion, with spasmodic attacks of coughing and an inclination to vomit. Later there was great weakness, loss of appetite but increased thirst. Cases also seen of headache, aching limbs, flatulence, diarrhoea. Sleepiness and lassitude were marked symptoms. No serious or fatal cases reported.

CHAPTER III

BLISTER GASES

5. Characteristics of Blister Gas

This is a group, the members of which possess certain special and peculiar characteristics. These characteristics are so important individually, and collectively produce so many difficult problems, that they are given below under five main heads.

First aid personnel are earnestly advised carefully to commit this list to memory. It is not claimed that every problem connected with this group can be solved by the direct application of any or all of the five heads set out. But it is definitely felt that serious mistakes are likely to be made unless the five heads are clearly grasped and completely understood, and unless their possible application to each individual problem is closely considered.

The outstanding characteristics of the group are:—

(1) *Persistence and power*

Members of this group are normally liquids, and liquids of a somewhat oily consistency. Under the normal weather conditions of a temperate climate they are capable of persisting even up to three weeks if the original contamination was heavy, and if sheltered from the direct action of sunlight and wind. All this time the contaminated area is dangerous to anyone coming in contact with it, and, moreover, the liquid is giving off, slowly but continuously, a dangerous vapour.

So far as the power of these poisons is concerned it may be said that a drop no bigger than the head of a small pin is enough to produce a blister the size of a shilling, and exposure to a concentration of the vapour of the order of one part in one million of air for one hour is capable of casualty production, more particularly by its effect upon the eyes, which are peculiarly vulnerable.

(2) *Penetration: (a) of materials, (b) of the body*

The power of penetration is an outstanding and important factor. It is a true penetration, or "soaking in," comparable to the soaking of ink into blotting paper, and is not an "eating in" as in the case of an acid. There is, indeed, no destruction of the material, and the ink-and-blotting-paper simile is good in that the penetration takes place in all directions, sideways as well as inwards. The power of penetration is almost universal, practically the only substances which will prevent it indefinitely being sheets of metal, glass, and highly glazed and resistant materials such as good quality tiles or porcelain. The human body gives no resistance to penetration.

(3) *Insidious character*

By this is meant that the presence of Mustard Gas may not be very obvious, either by smell or by producing any particular sensation such as burning or smarting.

The presence of Lewisite on the other hand can usually be readily detected by the smell.

(4) *Delayed action*

An important peculiarity is that whilst the actual damage takes place rapidly the recognisable evidence of this damage does not appear for a considerable time. Thus an individual can be contaminated without knowing it (insidious character) and may show no signs of damage from the contamination for as long as 24 hours. The average time, however, of development of clinical signs or symptoms is about four to eight hours for Mustard Gas, but rather sooner in the case of Lewisite.

(5) *Universal action*

Unlike the members of the other three groups, so far considered, which have an effect normally confined to certain areas of the body, the members of this group have the power of burning and blistering *any area* with which they come in contact, either as liquid or as vapour, whether within the body or on the surface.

6. Injuries produced by Blister Gas

The damage produced by the members of this group varies somewhat with the particular area affected, though they have the general effect of burning or blistering. Taking the areas of the body in the order of their relative sensitiveness or liability to injury, the damage shows itself as follows:—

(1) *Eyes*

Very liable to injury, whether from liquid or vapour, or both. Though there is some delay in the development of the damage this delay is less marked than in other areas of the body.

A few hours after exposure inflammation (conjunctivitis) sets in, with smarting, watering and finally closure from swelling of the eyelids. Conditions rapidly get worse, there is much pain, especially on exposure to light (photophobia), with discharge coming from between the swollen lids and trickling over the reddened and possibly blistered cheeks.

Actual destruction of the eye, and consequent blindness, is rare. Some impairment of vision may result from scarring left behind after healing, especially if the case has not been skilfully treated and nursed.

Should actual drops of liquid fall directly into the eye immediate irritation is produced. This effect passes off, to be followed an hour or so later by the rapid development of the above signs and symptoms. The effects are, in these cases, very severe, and destruction of the eye, with, of course, blindness, frequently follows.

(2) *Respiratory system*

Inflammation of the throat and the windpipe, as a result of breathing air contaminated by the vapour which these liquids give off, is fairly common. It produces a dry and burning mouth and throat, with a harsh, ringing cough, very characteristic and distressing. Laryngitis, with consequent partial loss of voice is common. In more severe cases burning of the lungs, followed by bronchitis and possibly pneumonia, with rising temperature and quickened pulse ensues. This can only result from long exposure to concentrations of vapour, without the protection afforded by the respirator. When it does occur it is serious, and dangerous to life.

(3) *Digestive system*

Inflammation of the stomach, with pain and vomiting, does occur. It is the result of swallowing contaminated saliva, or of the ingestion of contaminated food or drink. It does not prove serious as a rule, unless the contamination was by actual liquid, when the results might be very serious.

(4) *Skin*

Injury to the skin develops in three stages—reddening (erythema) with a fine rash not unlike nettle rash, blistering, and finally ulceration. How far the casualty progresses to the final ulceration depends on the original concentration and on the time of exposure to the poison. In the case of contamination by the liquid, however, blistering will always occur if steps are not taken at once to counteract the effects.

The areas of skin most likely to suffer from exposure to vapour are those which are normally moist, such as the bend of the elbows and knees, the armpit, the crutch and inner side of the thighs.

The genitals also are particularly liable to attack.

If the affection is widespread there is frequently much mottling of a brown to purplish colour; and a brownish staining often persists for some months after healing has taken place.

More or less scarring persists after the healing of these ulcers, but the scars are soft and supple and permanent disability as a final result of external damage is rare.

In general it is true to say that, while the number of casualties is high, due chiefly to insidiousness and persistence, the death rate is low—about 2 per cent. in the late war.

7. First Aid for Blister Gas

With the foregoing statements clearly in mind, and not forgetting the five special characteristics of this group enumerated in Section 5, the problems of first aid can be considered.

Before doing so, however, it is well to be quite clear that this is one of the cases in which " first aid " is entirely different from " treatment."

Further, it must be understood that first aid itself is more properly divided here into two heads, (*a*) first aid proper; (*b*) preventive treatment. This peculiar sub-division is due to the factors of " insidiousness " and " delayed action," as will become apparent later.

(1) *Eyes*

The only first aid for Blister Gas in the eyes is free washing, with either plain warm water, normal saline, or Sodium Bicarbonate solution about 10 grains to the pint. The points of importance are that the washing should be free, best done with some form of douche-can with rubber tubing and a nozzle, and that it should be carried out at the earliest possible moment after contact. A little vaseline smeared gently over the edge of the lids, or better still a drop or two of liquid medicinal paraffin in the eye, will help to prevent the lids sticking together if inflammation should occur in spite of all efforts. It must be remembered that the eyes are very susceptible to both vapour and liquid.

(2) *Breathing passages*

Cases in which signs and symptoms of damage to the breathing passages have developed, including the mouth and throat, scarcely fall within the province of first aid. Damage to these parts generally means that the individual has been exposed to a relatively high concentration of vapour for a considerable time. The case is likely to prove a serious one, indeed most of the deaths that occur are due to the results of lung damage, and should immediately be transferred to hospital for expert medical attention. The hard, dry, " brassy " cough, so characteristic of this condition, is one of the earlier and more easily recognised symptoms, as is the laryngitis and consequent loss of voice which has been already mentioned.

(3) *Digestive system*

These cases are characterised by pain in the stomach and vomiting. This can be temporarily relieved by draughts of warm Sodium Bicarbonate solution, 10 grains to the pint. But here again there are definite chances that the damage may turn out to be severe, and the cases require immediate hospital treatment rather than first aid ministrations.

(4) *Skin*

When the skin is considered, then the above-mentioned sub-heads, called for convenience of description " first aid proper " and " preventive treatment," become of importance, and must be clearly grasped. Their importance, and the fact that there is any such sub-division at all, is based on the following facts.

There is a delay of some hours between the time that the poison comes into actual contact with the individual and the time at which he develops recognisable signs or symptoms of damage. Yet, in fact, the damage has begun almost immediately, and the delay is in development rather than in occurrence.

If skin, to which Blister Gas had been applied a few minutes earlier, be examined under a microscope, this early damage to the tiny individual living cells of which the body is built can be seen. What happens is that the poison sinks rapidly into the skin, owing to its power of penetration and to the fact that it is freely soluble in fat, and then spreads, like ink into blotting paper, as mentioned above.

It damages at once the superficial area with which it first comes into contact, but it takes time for this damage to spread far enough to produce the final results of redness (erythema), blister, or ulcer.

The important points from the first aid point of view are:—

(i) Whether the time which has elapsed since contact is such that penetration of the skin is so deep that it is already too late to prevent injury developing?

(ii) How can the action of the poison be arrested?

The points have been put in the order of their importance. Throughout the first aid for Blister Gas *time* is the deciding factor. It is relatively easy to stop the action of the poison if first aid can be applied soon enough.

It must be quite clearly understood that these problems of first aid for Blister Gas differ, slightly but definitely, whether the liquid itself or the vapour from the liquid is being considered. Also, the difficulties produced by " Insidiousness " and " Universal Action " must be borne in mind.

There are, in effect, two possible lines of action; one is to destroy the poison by means of an antidote, and the other is to remove it by mechanical means, wiping or washing it away, before it has had time to penetrate too deeply.

The time actually available before penetration beyond the reach of first aid is very short. If serious damage is to be prevented, once the poison has reached the skin in the liquid form, the first aid must be applied in less than five minutes. In the case of contamination by vapour this time is definitely longer, and the combined effect of concentration *and* time is the deciding factor—as in all cases of poisoning by chemical warfare agents. The lower the concentration the longer the time of exposure required to produce damaging results, and *vice versa.*

The application of an antidote seems to have a quicker and more thorough action than mechanical removal, and this is therefore the best choice for cases in which there are actual drops or splashes of liquid on the skin.

The only really efficient antidote, an antidote which will rapidly reach, kill, or make the poison harmless, and which is at present available, is Chlorine in some form or another.

Bleaching powder (that is, chloride of lime) is the best known and most generally useful form, and for skin contamination it can be used as a paste or an ointment. The paste is made by adding small quantities of water to super-tropical bleach and stirring continuously until a paste of a consistency of thick cream is obtained; this will usually be achieved by the use of equal volumes of bleach and water. The ointment is supplied already compounded, but can be made by mixing equal parts by weight of bleaching powder and white petroleum jelly, such as white vaseline.

Cover the contaminated area and the immediately surrounding skin with bleach ointment or paste, rub well in for about a minute and then remove, by wiping with a dry rag in the case of the ointment, and by washing off with plain water in the case of the paste. A subsequent bath with soap and water is desirable if it can be given.

This treatment must however only be used as true first aid. *The application of bleach in any form to a skin which is already showing signs of damage will aggravate the ensuing burn.*

Care should in any case be taken to prevent the bleach getting into the eyes. Should it be possible actually to see liquid blister gas on the skin this should be rapidly mopped off with a rag before the antidote is applied, care being taken to avoid spreading the contamination. The now contaminated rag should then be burnt, or otherwise disposed of.

This is true first aid: it must be applied within a few minutes of contamination occurring, and, in practice, is only for those cases in which known contamination of skin by liquid mustard gas has occurred. But, owing to the insidious character and the persistence of the poison, the great majority of the cases of contamination will not be of that class at all. They will be cases who know, or think, they have been splashed but have no very clear idea of just where. Or they will be cases in which the clothing has become contaminated, either directly or by coming into contact with some infected person, thing, or place. Or they will be people who have been in an area where the vapour was present.

With regard to contamination by liquid through clothing it is important to remember that only vapour reaches the skin, unless the contamination is so gross as to soak the clothing and wet it right through.

In all these cases, whatever procedure is adopted, it must include the removal of all clothing and the treatment of the whole body. Firstly, owing to persistence, anything contaminated remains a danger until decontamination has been carried out; and secondly, owing to universal action, any and every part of the body is open to attack.

Therefore, for this class of case the method advocated is mechanical removal, by means of thorough washing with ordinary soap and warm water.

But this is not true first aid. It obviously cannot be carried out on the spot. Somewhat elaborate provision is required. For these reasons the procedure is best thought of, not as " first aid " but as preventive treatment, and special facilities must be arranged for it in First Aid Posts.

Summary

(*a*) The essence of first aid for Blister Gas is prompt action.

(*b*) True first aid, for direct contamination—apply ointment within a few minutes, or, if none available, at least mop off contamination with handkerchief or rag (which must then be thrown away in a safe place), and proceed immediately to—

(*c*) Preventive treatment, for indirect contamination —stripping and complete washing at the earliest possible moment, with or without the use of bleach paste.

(*d*) Keep the contaminated, whether persons or things, away from the uncontaminated until the proper cleansing procedure has been carried out.

(*e*) The contaminated clothes must be dealt with, whether they are known to have been contaminated or whether, owing to insidiousness and persistence, contamination is only suspected.

The clothing must be collected into receptacles, preferably metal bins with close-fitting lids, in such a way that they will not be a danger to others. It must then be dealt with in the appropriate way by the decontamination of clothing section of the local A.R.P. organisation.

8. Notes on Mustard Gas and Lewisite

The two chief members of this group of Blister Gases are Mustard Gas and Lewisite. They each possess the general characters of the group, but they differ in certain rather important details, and it is convenient to list those differences here, though there is no essential difference in first aid.

Mustard Gas	*Lewisite*
1. Entirely insidious	1. Presence easily detected
2. Has a feeble and not very definite smell	2. Has a strong and definite smell of geranium
3. Produces no immediately appreciable effect upon any part of the body (unless a drop gets into the eye, when a mild irritation will be felt)	3. The vapour, if breathed for a few moments, produces an intolerable sensation of burning and irritation in the nose; the liquid produces a sharp tingling in contact with the skin, and immediate severe pain if a drop falls in the eye
4. Cold or warm water has practically no effect except after long periods of time, i.e., days or weeks, but boiling water destroys fairly rapidly	4. Contact with water at any temperature rapidly destroys

Mustard Gas	*Lewisite*
5. Immediate application of aqueous bleach paste or bleach ointment is effective in preventing burns	5. Immediate application of aqueous bleach paste is effective in preventing skin burns, but bleach ointment is of little value
6. Is extremely persistent	6 Not so persistent, very largely because of the action of water
7. Effects are local and no general poisoning is caused	7. When the skin has been heavily contaminated symptoms of arsenical poisoning may accompany those caused by burning
8. Blisters should not be broken	8. Blisters should be broken because they contain arsenic

9. Treatment of Developed Damage

Treatment of developed damage is rather a matter for the doctor than for first aid. But late cases may find their way to a first aid post and the following hints are intended for guidance in the management of such cases pending medical attention, or in cases so mild that the services of a doctor are not required.

The first stage of skin burning, i.e. erythema (rash) without blistering, is extremely irritating, and is apt to produce considerable exhaustion from loss of sleep, because the intolerable itching tends to come on most at night. This itching is very difficult to treat, but the free application of any of the following solutions can be tried:—

Potassium permanganate: 1/10,000.
Tincture of iodine: a few drops to ½ pint of water.
Sodium bicarbonate: saturated solution.
Lotio calaminae.
Any evaporating lotion.

After free swabbing of the area, and light drying with a soft towel, plenty of dusting powder should be applied. For this purpose a simple preparation should be used, such as:—

$\left.\begin{array}{l}\text{Zinc oxide}\\ \text{Starch}\\ \text{Boric Acid}\end{array}\right\}$ equal parts.

If a case is met with in which blisters have developed every effort should be made to preserve these blisters unbroken until medical attention can be given.

If, however, it is known, or suspected, that the blisters have been caused by Lewisite then they should be opened and the blister-fluid evacuated at once under the usual surgical cleanliness. The reason for this is that Lewisite contains arsenic, and there is a possibility of general poisoning through absorption from the blister-fluid.

In the case of eye damage (for which medical aid should be sought immediately), the patient will find comfort from the use of an eyeshade, but bandaging of the eyes should on no account be permitted.

CHAPTER IV

OTHER POISONOUS SUBSTANCES

The substances dealt with in this chapter are not likely to be used as offensive agents, but are liable to be encountered under peace or war conditions.

10. Carbon Monoxide

This gas is produced when certain materials burn under circumstances in which the supply of air or oxygen is restricted. It is one of the gases liberated in the explosion of high explosives, it is given off in the exhaust gases of motor engines, and a considerable proportion is present in ordinary coal gas. It forms the deadly constituent in the so-called "after damp" which is formed in a colliery explosion.

The following are typical instances of its occurrence:—

(1) In the interior of burning buildings.

(2) When a coke brazier burns in a badly ventilated room.

(3) When the engine of a motor car is allowed to run in an ill-ventilated garage, or when, owing to a faulty joint, the exhaust gases gain entrance to the interior of a closed motor vehicle.

(4) When coal gas escapes into an occupied room. During war, gas mains or pipes may be fractured by bombs and the escaping gas may penetrate into an adjoining house.

> N.B.—A mixture of coal gas and air is highly explosive. Never use a naked light when investigating a supposed leakage of gas.

(5) When the fumes of a high explosive shell or bomb which has burst underground penetrate into a cellar or the interior of a building, or when a shell or bomb bursts within a building.

Carbon monoxide is non-irritant and is particularly dangerous because the onset of symptoms may not be recognised in time to allow of retreat to safety.

The respirator gives no protection against carbon monoxide.

Symptoms.—When air containing a small proportion of carbon monoxide is breathed, the first effect is giddiness and loss of power in the limbs. In some cases there is also a period of marked mental excitement. Continued exposure to the gas may cause unconsciousness and death.

Treatment.—The poisoning effect of this gas is due to its being easily absorbed by the blood, where it seriously reduces the capacity of the blood to carry oxygen. The first essentials of treatment are therefore the removal from the poisonous atmosphere into pure air, and the avoidance of any exertion, which would increase the requirements of oxygen. If the breathing threatens to fail, artificial respiration must be employed, and oxygen (or oxygen containing 5 to 7 per cent. of carbon dioxide) should be administered, if available.

In all cases the usual " anti-shock " steps must be taken, particular attention being paid to the provision of rest and warmth.

A close watch must be kept on the patient after restoration to consciousness as relapse is not infrequent, and if this is not treated death may ensue.

11. Nitrous Fumes

These are produced in the course of various chemical processes, but more particularly through the burning of cordite.

Symptoms.—The first symptoms at the time of exposure are slight irritation of the nose and throat, together with an irritating cough, headache and possibly vomiting. These symptoms soon pass, and a latent period of some hours follows during which the patient feels quite well. In cases of serious poisoning acute symptoms of a similar type to those referred to under Lung Irritants follow the latent period.

Treatment.—In these cases immediate removal to hospital for medical attention is essential.

12. " Paralysing " Gases

There are two gases coming under this head which might be met with in war. They are:—

Hydrocyanic (Prussic) Acid.
Sulphuretted Hydrogen.

Both have already been used in war, but with little success. Nevertheless, improved methods of employment might bring them back into use.

Moreover, Sulphuretted Hydrogen gas is sometimes present in the air of sewers in sufficient concentration to be dangerous. Leakage into cellars or houses as a result of air raid structural damage might possibly occur.

Hydrocyanic acid has the smell of bitter almonds, whilst the smell of Sulphuretted Hydrogen is that of rotten eggs.

Both gases need to be in rather strong concentration before the danger point is reached, but, in addition, a chronic form of poisoning from repeated small doses of Sulphuretted Hydrogen is possible, though hardly likely.

Sulphuretted Hydrogen is highly inflammable and when mixed with air will explode if it comes into contact wth a naked flame.

Hydrocyanic Acid is lighter than air, Sulphuretted Hydrogen is heavier than air.

In a case of acute poisoning by strong concentrations of either of these gases the onset is sudden and serious.

Symptoms are ushered in by uneasiness and dizziness, rapid heart beat and breathing. Unconsciousness and convulsions follow rapidly, and death occurs through paralysis of the respiratory centre and failure of the respiration.

Treatment must be immediate. Prompt removal from the poisonous atmosphere, artificial respiration with, if possible, the administration of oxygen. A valuable addition to the oxygen is 5 to 7 per cent. of carbon dioxide. This latter stimulates and increases respiration and so helps to flood the lungs with the oxygen and wash out the poison from the blood.

The patient must, of course, be kept warm.

The respirator gives a satisfactory degree of protection against both these gases.

13. Phosphorus Burns

White phosphorus is used as a smoke producing material and may be scattered from shell, or bombs. The solid particles catch fire when exposed to air. If these particles land on clothing, or come into contact with the skin, they will cause severe burns. Clothing on which phosphorus is burning should be ripped off, and where phosphorus is burning on the skin, air must be excluded by immersion in water, or the application of wrappings, soaking wet. Great care must be taken to remove all phosphorus from the burn. Phosphorus melts at 112° F., so that if the part is immersed in warm water the molten substance can be removed under water, or wiped off with a gauze sponge held in a forceps. Great care should be taken to remove every particle. Subsequent treatment is similar to that advocated for ordinary burns, but oils or fatty dressings should not be applied unless it is certain that all the phosphorus has been removed.

A first aid method advocated by American writers is to cover the affected area with a 3 per cent. solution of Copper Sulphate (Blue-Stone), or with rags soaked in the solution. The action is to coat the phosphorus with an inert compound produced by reaction with the solution, and so to put a stop to the burning.

CHAPTER V

HANDLING OF GAS CASUALTIES

14. General Guidance

The treatment of gas casualties will be part of the duties of the general organisation responsible for civilian casualties.* A large measure of elasticity is essential therefore in preparing schemes, and in planning the arrangement of first aid posts, to ensure that they are adequate to meet whatever situation may arise.

This handbook deals principally with the effects of gas, but it may be assumed that gas casualties will not be entirely separable from those due to other causes. Persons who have been injured by splinters or falling masonry may also be contaminated with persistent gas, and will continue to be a danger to themselves and others until action is taken to get rid of the contamination.

Again, if persistent gas is used in any quantity there will probably be large numbers of persons otherwise uninjured, who will require cleansing treatment. Individuals whose clothing has been contaminated by persistent gas should remove the clothing, wash thoroughly and completely, and change into fresh clothing, *as quickly as possible.* If these precautions can be carried out within about 20 minutes of the initial contamination serious injury may be avoided. Moreover, the risk will be much reduced if outer garments, overcoats, wraps, mackintoshes, jackets, etc., which are known to be contaminated are removed *immediately*.

These measures can be taken at home, under the precautions recommended in A.R.P. Handbook No. 1. To meet the case of those who cannot get home and obtain the necessary treatment sufficiently quickly, within 20 minutes at most, public facilities will be provided at first aid posts.

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* The organisation of this service is described in A.R.P. Memorandum No. 1.

In the event of a mustard gas attack on a large town some persons who have actually been exposed to the gas may, owing to local conditions, be unable to get away from their places of business before the inflammation of the eyes has become severe. If for that reason they can no longer see they should be treated like blind persons and should be conducted to the first aid post, the hospital, or their homes, as the case may be. The personnel of the first aid services should be prepared to give their assistance in such cases, and it need only be pointed out that if this type of casualty is numerous it is possible to collect a small number of them into a party, each man holding on to his neighbour, when a single guide can lead the whole party.

15. How to Detect Gas Casualties

The first requirement is to decide quickly who are gassed and who are not, and the second, which group of poisons is concerned.

Many may think that they have been gassed, but it does not follow that they have received injury or require treatment. They may be entirely mistaken, or they may have smelt a trivial concentration. It is often difficult to reach a decision, but the following facts should be borne in mind.

The effects associated with the various groups of chemical warfare agents are reasonably definite. They must be closely studied, comparing one group with another, clearly understood and carefully memorised.

In the light of this knowledge a rapid examination and questioning of the patient will often give a clue to the answer. A final decision will frequently rest on a combination of negative with positive observations.

That is to say, the *absence* of certain facts, whether observed or elicited by questioning, plus the *presence* of certain other facts will often be of great assistance. Doubt might arise, for instance, as to whether a certain casualty were suffering from the effects of tear gas, or lung irritant gas. The *presence* of lachrymation might be due to exposure to tear gas or to a strong concentration of lung irritant gas; but if other symptoms, such as coughing and tightness of the chest, were *absent,* this would be strong evidence in favour of a diagnosis of simple tear gas infection.

In general it may be said that the detection and differentiation of gas casualties depends on a consideration of one or more of the following points:—

(i) smell or other indications of gas (splashes);
(ii) clinical signs and symptoms of casualty;
(iii) the casualty's own statements.

A careful study of the Table of Gases in the Appendix is recommended.

Whenever there is doubt the benefit must be given to the casualty. It must then be accepted that he has been gassed, and the requisite steps taken accordingly.

Only cases in which there are definite reasons for assuming exposure to gas should go to the first aid post. Others should be advised to return quietly to their homes and lie down, and to obtain medical advice if not completely recovered in a few hours.

Personnel of the first aid parties must take every care to avoid becoming casualties, either by contact of themselves or their clothing with places or things contaminated by persistent gas, or by breathing air containing poisonous vapour coming off the clothing of their patients. They must use their own judgment with regard to the wearing of respirators and protective clothing.

When it is definitely known that persistent gas has been used in an area it is essential that the respirator and suitable protective clothing should be worn. If only non-persistent gas is suspected, the carriage of the respirator in the "Alert" position, ready for instant donning, may be a sufficient precaution.

16. Combined Gas and Wound Casualties

There may be cases of persons who have received injuries necessitating first aid and who are also casualties from, or contaminated by, gas.

If chlorine or phosgene (lung irritant gas) poisoning is suspected, convey the person on a stretcher as quickly as possible to the ambulance: keep him warm whilst doing this and loosen the clothing round his neck.

Should the patient's clothing smell strongly of any gas, the outer garments must be removed and the person wrapped in a blanket or other covering before removal.

In all such cases of contamination an oilskin sheet should be spread over the stretcher before lifting the patient on to it. Oilskin gloves and other suitable anti-gas clothing should be worn by the first aid personnel before handling the casualty.

When moving through a gassed area care must be taken to adjust the respirator on the casualty, whether he be a stretcher case or no. (See Appendices A and B to A.R.P. Handbook No. 1 for instructions how to do this.) In the case of head injuries it is often possible to use the facepiece and the headharness elastics in lieu of a bandage. By doing this, where possible, the distortion, and consequent danger of leakage, resulting from an attempt to apply the facepiece over both dressing and bandage can be avoided. Failing this, the facepiece can be placed over the patient's face, the head-harness being brought over to the front.

This is nothing more than a desperate remedy to meet a desperate case. Naturally it will be almost impossible to keep the facepiece close enough to the face to make a gas-tight fit. Yet, as a purely temporary expedient when no other course is possible, the amount of protection given is by no means negligible.

A decision will have to be made whether to send the casualty to a hospital or to a first aid post. Cases appearing to require immediate surgical attention should be sent to hospital by ambulance. Minor injuries, including even simple arm fractures, and gas cases unless severe, should be sent to the first aid post for removal of the gas contamination, because the facilities for this latter at hospitals will necessarily be limited and the staff fully occupied with serious surgical cases.

The public should be advised not to apply for treatment at hospitals. They will receive more prompt attention by going to a first aid post.

As far as possible, the first aid dressings applied to casualties when first picked up should be of such a nature that they will not interfere with the removal of the clothing, and that no re-dressing will be necessary before the bathing or washing of the patient.

As soon as a patient is received at the first aid post or hospital, his contaminated clothing should be removed, cutting away being resorted to if necessary. Such first aid or surgical attention as is *immediately* required should then be given, and the patient handed over for removal of contamination from his skin. After thorough cleansing he should be dealt with in the normal routine as for other surgical cases.

CHAPTER VI

NOTES ON THE NURSING OF GAS CASES

The hospitals taking air raid casualties will need augmented nursing staff, possibly drawn from the St. John Ambulance Brigade, the St. Andrew's Ambulance Association, and the British Red Cross Society, or from other sources, and these nurses will need training for their duties.

This chapter is intended as a guide for both professional nurses and others, many of whom will be without experience of patients suffering from gas poisoning. It illustrates some of the special nursing problems which those cases present.

17. Nursing Essentials in Gas Cases

Cases may need hospital care on account of disability caused by gas. There may also be wounded and injured who are suffering from the effects of gas as a complicating factor.

Such patients need gentleness and firmness in the care of both mind and body. All ordinary nursing cares must be intensified. Fear, anxiety for relations and friends, pain, or shock—even unconsciousness—may be present, as well as injury. These cases are physically and mentally depressed; sepsis and pressure sores must be guarded against.

Shock.—As all patients will be suffering from some degree of shock, the first essentials are warmth, complete rest and fresh air. They must be reassured as soon as possible that their troubles, however trying, are temporary, and, above all, they must be encouraged to be hopeful.

Eyes must receive the earliest possible attention.

Cleanliness of the skin, with removal of hair, may prevent later complications. Remember that the effects of some gases are delayed—the skin may already be injured, although nothing shows: therefore cleansing must be gentle.

Clothing, both bed and personal, should be light, loose and warm.

Pillows should be arranged according to the degree of shock and the comfort of the patient. To allow the escape of fluid by the mouth, the patient's head and shoulders should be supported and turned to one side. Supply other bed accessories according to the case. There should be plenty of mackintoshes, cradles, hot water bottles and back rests.

Rest.—Complete rest implies quiet, no fuss, and the nurse thinking and acting for the patient. In particular, cases suffering from the effects of the Lung Irritant Gases must be spared all physical exertion.

Constant observation.—Each case requires constant and accurate observation because of the necessity to report at once any odd, alarming or new symptoms.

Diet must be liquid, warm and nourishing. There may be vomiting, in which case copious draughts of warm water and sodium bicarbonate (60 grains, i.e., a level teaspoonful, to water 1 pint) may be ordered.

Thirst is not an outstanding feature. Patients must be watched and encouraged to take sufficient fluid.

Records accurately kept may save life; inaccurate records may endanger it.

18. Nursing of Tear Gas Cases

These cases are unlikely to be admitted to hospital. Even if they are admitted, the effects are so transient that no nursing problems arise. If still complaining, the patient may bathe his own eyes with plain warm water and, when time permits, the nurse may instil a drop of oil—olive oil, medicinal paraffin, or castor oil—into the eyes.

19. Nursing of Nose Irritant Gas Cases

Nurses will not often meet these cases because they are normally so slight and recover so quickly. But, should the exposure have been abnormally long or severe, there may, in rare cases, be more serious developments, including acute mental depression, occasionally leading to suicidal tendencies.

The initial coughing and sneezing may be followed by giddiness, occasionally merging into unconsciousness. Patients are often mentally dulled and apathetic, and disinclined to exert themselves.

A possible early complication is a temporary paralysis of one or more limbs; this soon passes off. The weight of bed clothes should be supported by bed cradles.

Later, sometimes after about four days, there may be numbness or shooting or neuritic pains in arms and legs. These symptoms may cause alarm, under the apprehension that they arise from injuries other than poisoning by Nose Irritant Gas.

In addition to ordinary nursing care, some patients are relieved by nasal douching with a weak solution of sodium bicarbonate (60 grains, i.e. a level teaspoonful, to a pint of warm water), or by a gargle or draught of the same, or they may slowly suck lozenges or jujubes to induce a flow of saliva.

Symptoms of arsenical poisoning, such as restlessness, irritation of skin or mucous membrane, pain in throat and abdomen, sickness, etc., must be watched for. Eyes will need attention.

20. Nursing of Lung Irritant Gas Cases

All such cases must be admitted as stretcher cases, and require *complete rest,* with sparing of all exertion, extreme gentleness in handling, and constant attention.

The condition of the patient on admission depends upon the degree of lung damage already developed. This damage, as it develops, causes difficulty in breathing, oxygen want and heart strain.

The clinical picture depends upon the degree of pulmonary oedema produced. In an advanced case, the face and neck are flushed and cyanosed, the alae nasi and the accessory muscles of respiration are in action, and the pulse is increased in rate and usually in volume; in other words, the appearance is one of oxygen starvation, masked by the accompanying increase in carbon dioxide, and cases of this type are sometimes referred to as being of the " blue type."

If this condition is allowed to proceed unchecked, heart failure supervenes; this is indicated by an increasing pallor—sometimes this stage is described as the " grey type "—and a diminution in the volume, but not in the rate, of the pulse, which becomes running and thready.

Oxygen is always called for. See Appendix B for routine of administration.

Venesection, with or without intravenous saline infusion, may be ordered.

Sedatives may be ordered; but morphia is contraindicated since it tends to depress the respiratory centre.

Heart stimulants, such as hypodermic injections of pituitrin or camphor, may be ordered. Expectorants should be withheld from all but the mildest cases until they are well on the way to recovery.

Raising the foot of the bed, a few minutes at a time, sometimes relieves the " waterlogging " of the lungs, by assisting the patient to get rid of the exudate.

21. Nursing of Blister Gas Cases

This section does not deal with the problems of preventive treatment (or cleansing) of Blister Gas cases, nor with the appropriate first aid, all of which have already been dealt with in Chapter III. It refers to cases in which damage is already recognisable.

Nursing care has three main objects:

(*a*) the prevention of secondary infection;
(*b*) the healing of actual injury; and
(*c*) suggestion and tactful firmness to combat the patient's tendency to introspection and neurasthenia.

Effects of Blister Gases are delayed for periods varying from 2 to 48 hours.

Eyes.—The patient must be reassured that his sight will not be lost. Severe inflammation results from contamination, either by vapour or liquid, the latter being more serious. The swollen conjunctivae often protrude between the inflamed and oedematous lids. The lids are painful; the discharge soon becomes purulent.

Treatment: immediate, frequent and copious irrigation with a warm solution of sodium bicarbonate (4 drachms, i.e. a level tablespoonful, to water 1 pint) followed by instillation of drops of liquid paraffin, olive oil, or castor oil. The eyes must not be bandaged, but an eyeshade may help. Drops of a 2 per cent. solution of argyrol or protargol may be ordered. Frequent bathing or hot applications *outside* the lids may help to relieve the pain.

Nose and Throat.—Sneezing, coughing, and hoarseness may be eased by gargling and douching with any bland solution, spraying with parolein or any suitable antiseptic, or by inhaling steam from a pint of boiling water containing a teaspoonful of a mixture of menthol grains 10 in tinct. benzoin co. 1 ounce. Patients should breathe through a perforated mask such as a Burney Yeo inhaler containing a pad of gauze or muslin moistened with an antiseptic and pain-deadening mixture as may be prescribed by the doctor.

Secondary bronchitis or broncho-pneumonia may occur in cases showing damage to the respiratory tract. It is, therefore, wise whenever possible to treat cases suffering from any affection of the respiratory passages in a separate ward.

Skin should be *gently* cleansed with soap and warm water, and the hair on the affected areas clipped. Erythema is frequently followed by blisters which may result in ulceration. Every effort must be made to prevent secondary infection of these raw surfaces.

The itching of the early inflammation may be relieved by the application of calamine or other alkaline lotions, dusting powders or ointments as prescribed. Blisters must be opened under aseptic precautions, and the blister fluid carefully removed; devitalisation of skin and tissues makes healing slow and difficult. Dressings of old sterile linen are best. Gauze is not recommended, since it tends to stick. The use of oiled silk, or similar material which retains discharges, must be avoided. The scar is weak, and for some time after healing must be protected.

Lewisite injuries.—Lewisite has greater rapidity of action than Mustard Gas. Penetration of the skin is much quicker, and irritation is intense. The serum from the blisters must be evacuated aseptically, the epithelium removed and the raw surface irrigated, in order to lessen the risk of arsenical absorption, which might result in kidney and liver involvement and gastric and abdominal disturbances. The patient's eyes must be irrigated and the same general measures taken as for injuries by Mustard Gas.

22. General Principles for Nursing all Gas Cases

Pure air and rest are the first needs. All strain on the heart and lungs must be avoided or relieved, and treatment should be carried out according to instructions or as indicated by the condition of the patient.

It is impossible to give specific directions for the nursing of all types and complications of cases. The nurse must exercise her common sense for the comfort and well being of her patient, and be guided by his condition and by the principles learnt in her general training.

Convalescence.—It must be remembered that this period is long and tiresome for both nurse and patient. The nurse all along must reassure and give hope; she must help her patients to help themselves and encourage them to " take an interest."

APPENDIX A

TABLE OF GASES

Example.	Properties.	Effects.	Remarks.
Tear Gases—			
Chlor-aceto-phenone (C.A.P.) (*non-persistent*).	A solid. Almost invisible in gaseous state. Recognised by irritation to eyes.	Irritation or stinging of eyes followed by copious flow of tears and spasm of eyelids. Slight skin irritation.	Respirator affords complete protection.
Ethyl-iodo-acetate (K.S.K.) (*persistent*).	A dark brown liquid. Invisible in gaseous state. Recognised by irritation to eyes.	Do., but no skin irritation.	Do.
Bromo-benzyl-cyanide. (B.B.C.) (*persistent*).	A yellowish-brown crystalline solid when pure. As used—a liquid mixture. Invisible in gaseous state.	Similar to K.S.K.	Do.
Nose Irritant Gases—			
Di-phenyl-chlor-arsine (D.A.) (*non-persistent*).	A colourless, crystalline solid which when heated gives off an almost odourless smoke. Generally invisible except near the source. Can still be effective although not visible.	Produces sneezing; burning pain in chest, throat, nose and mouth; mental depression.	Do.

APPENDIX A—*contd.*

Example.	Properties.	Effects.	Remarks.
Nose Irritant Gases—*contd.*			
Di-phenyl-chlor-arsine (D.A.) —*contd.*	Recognised by effects, which are slightly delayed.		
Di-phenyl-amine-chlor-arsine (D.M.) (*non-persistent*).	A bright yellow, crystalline solid. General properties similar to D.A.	Produces sneezing ; burning pain in chest, throat, nose and mouth ; mental depression.	Respirator affords complete protection.
Di-phenyl-cyano-arsine (D.C.) (*non-persistent*).	A crystalline solid with properties similar to D.A.	Do.	Do.
Lung Irritant Gases—			
Chlorine (*non-persistent*).	A gas—greenish colour. Corrodes metals. Is dissolved in water. Will eventually rot clothing. Smell of bleaching powder.	Highly lethal, owing to damage to lungs. Early symptoms : cough and watering of eyes. Signs of lung damage develop later.	Do.
Phosgene (*non-persistent*).	A gas—almost invisible. Corrodes metals. Is rendered less effective by heavy rain. Smell of musty hay.	Do.	Do.

Di-phosgene (*non-persistent*).	A colourless liquid. Invisible in gaseous state.	Do.	Do.
Chloropicrin (P.S.) (*semi-persistent*).	A colourless, volatile liquid with a pungent odour.	Generally similar to above. Also causes sickness and slight irritation of eyes.	Do.
Blister Gases—			
Mustard gas (H.S.) (*very persistent*).	An oily liquid which may vary in colour from dark brown to straw yellow. Soluble in oil and spirits. Neutralised by bleaching powder. Great power of penetration. Smell of garlic, onions, horse-radish or mustard. Liquid may be seen.	(i) *Vapour.* (*a*) In eyes; irritation and inflammation with swelling and temporary loss of vision usually develop within 24 hours, but tears earlier if the vapour concentration is high. (*b*) In lungs; loss of voice, and cough. Later possibly bronchitis and broncho-pneumonia. (*c*) On skin; redness, irritation and perhaps blisters; but to an unprotected man, the eye damage is worse than the lung or skin effects. (ii) *Liquid.* (*a*) In eyes; immediate irritation, eye closes in about one hour. (*b*) On skin; no irritation, redness in 2 hours followed by blister in 12 to 24 hours.	Respirator protects eyes and lungs only.

APPENDIX A—*contd.*

Example.	Properties.	Effects.	Remarks.
Blister Gases—*contd.*		(ii) *Liquid*—contd. (*c*) The effect of swallowing food contaminated by liquid mustard gas is severe injury to stomach and intestines.	
Lewisite (*very persistent, but less so than mustard gas*).	A colourless liquid when pure; brown in the crude state. Gives off an invisible gas. Is rapidly destroyed by water and any alkali. Great power of penetration. Has a low freezing point. Smell of geraniums.	(i) *Vapour.* Causes severe irritation to nose. Hence respirator will be adjusted immediately so that there will be no permanent effects on eyes, nose or lungs. Is less effective on skin than mustard gas vapour. (ii) *Liquid.* (*a*) In eyes; immediate effect and permanent injury. (*b*) On skin; blisters develop more rapidly than with mustard gas.	Respirator protects eyes and lungs only.

Paralysant Gases—			
Hydrocyanic acid (*non-persistent*).	A colourless, volatile liquid with a smell of bitter almonds.	Small amounts of vapour cause giddiness and headache ; larger doses cause unconsciousness and death.	Respirator affords complete protection.
Hydrogen sulphide. (*non-persistent*).	A colourless gas with characteristic smell of bad eggs.	Small doses cause irritation of eyes and nose ; large doses cause unconsciousness and death.	Do.
Other Gases—			
Carbon monoxide. (*non-persistent*).	A colourless, odourless gas.	Causes giddiness, tiredness, then unconsciousness and death.	Respirator does *not* protect against this gas. Unlikely to be used as a war gas on account of its physical properties.
Nitrous fumes (*non-persistent*).	Reddish-brown fumes. Pungent smell.	Irritation of nose, throat and lungs.	Respirator gives adequate protection for limited periods.

ROUTINE OF OXYGEN ADMINISTRATION

The cases requiring oxygen treatment should be aggregated in wards set apart and specially equipped for their reception.

The cylinders* of oxygen, one for each bed with a 50 per cent. reserve, are best grouped as a battery of cylinders. This grouping of cylinders should be arranged close to, but outside, the actual ward, in a lobby or passage. This permits of cylinder replacement being carried out by an untrained orderly or porter without his actually entering the ward. Every cylinder should have its pressure gauge and the orderly can very soon be trained to watch these gauges, to detach individual cylinders as and when the gauge shows it to be necessary, and to replace it by a fresh cylinder from the immediately available reserve. He can also be responsible for replenishing the local reserve from the hospital general store at definite times arranged with the hospital quartermaster or storekeeper. All this can be done without any interference with ward routine if the cylinder group is outside the ward.

The cylinders should be connected to a main storage and break-pressure tank by means of individual pipes leading to a manifold. From this tank one main pipe should lead down each side of the ward, for the full length. These pipes may be connected at the other end to form one circuit. There should be a T-piece over each bed to provide a separate supply for each patient. Each of these bed-leads should have a Haldane administration apparatus, or some modification of that principle, complete with graduated flow control and administration mask or tent.

For the continuous and long-continued administration which these cases demand this centralised layout is more satisfactory, more economical of nurse-power, and easier to control than a bed-by-bed layout. The fittings can be made of lead or gas piping, and can be fixed permanently in position. A part, if not the whole, of the individual bed-leads must be of rubber tubing.

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* Contents of cylinder, 20 cub. ft. = 560 litres.

When the layout is complete the cylinder valves can be opened and each separate administration unit tested for a satisfactory oxygen flow.

Administration can best be carried out by a Haldane apparatus (or some modification of it), but if not available it can be done by the nasal catheter or double nasal catheter.

The great advantage of the special apparatus is that the flow is mechanically controlled, and the actual quantity being given is shown on the graduated control tap. Moreover, wastage during expiration is avoided by the system of valves and collecting bag which is part of the apparatus. These two factors combine to reduce avoidable waste of oxygen. This is a most important matter if many cases have to be treated over long periods since under war conditions there may be serious difficulties of supply and distribution.

The ward is now equipped and ready to receive patients, and routine treatment may begin. This routine, as applicable to any one patient, will now be followed through.

Whenever possible, oxygen administration should be in the hands of nurses specially detailed and coached for this work, the whole of the general nursing being carried out by other members of the nursing staff.

It is best if one nurse, doing oxygen administration routine, has five beds. These beds must all be in one ward and running in sequence, not dotted about.

The nurse must have a time sheet or note book, and each bed must have a bed-head writing pad or, better still, a slate.

At the time of beginning oxygen administration to any given patient the nurse makes two entries: in her note book, the time to the nearest minute, *but adding 25 minutes;* on the patient's bed-head pad or slate, a short note of the clinical condition in simple terms under three heads, (1) general demeanour of case, (2) colour, (3) condition of pulse.

It is well to begin every administration at a flow rate of 3 litres per minute. Almost immediate clinical improvement, especially of the colour, is the criterion of whether the flow is rapid enough. In the absence of this expected improvement, it is permissible to increase the flow, but it is no use increasing it beyond 10 litres per minute. Any more rapid flow will merely result in avoidable wastage without any advantage being gained. If the hoped for clinical improvement is not evidenced with this maximal permissible flow of 10 litres per minute it means that the case is all but hopeless. In a few cases the flow can be cut down below 3 litres per minute.

The rate of flow having been adjusted and some clinical improvement being established, this patient ceases to be the responsibility of the nurse in charge of oxygen *for the next 25 minutes.* During this period it is the responsibility of the other members of the nursing staff to see that the administration is as uninterrupted as is humanly possible.

At the end of the 25 minute period, marked for her on her time sheet by having added 25 to the original time of starting oxygen, she returns to this particular bed.

She alters the bed-head notes as required by the new condition of the patient. She turns off the oxygen and the administration is discontinued for five minutes (this period also is noted on the time sheet, and worked to by the nurse, in minute periods). At the end of the five minutes, or sooner if the clinical signs evidence any retrogression, the administration (if still required) is restarted for another 25 minutes.

This routine of 25 minutes on, five minutes off, 25 minutes on, five minutes off, is continued *until the five minutes' interval produces no clinical setback.* If and when this stage is reached, it is usual to find that a turning point has been reached, no further oxygen is needed, and recovery is certain unless there should be a relapse due to some unexpected sequela such as pneumonia.

The danger which is being fought is the very serious one of oxygen starvation, against which the patient cannot stand up for very long.

Official Publications on Air Raid Precautions

HANDBOOKS—
See list on page i within.

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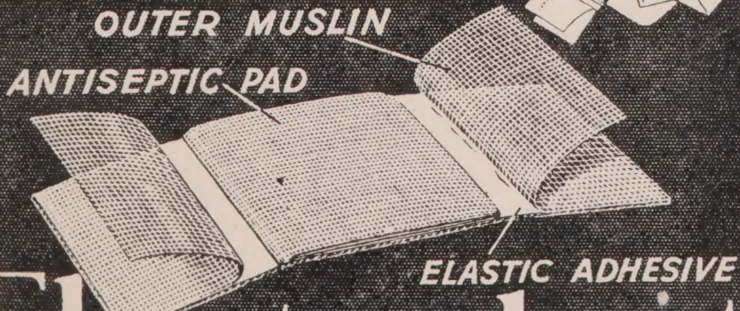

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